DOCUMENT RESUME

ED 161 300 FL 009 837

AUTHOR Pierce, Sandra; Bartolucci, Giampiero
TITLE Phonological Production and Perception in Verbal Autistic, Normal, and Mentally Retarded Subjects. Papers and Reports on Child Language Development, No. 12.
INSTITUTION Stanford Univ., Calif. Committee on Linguistics.
PUB DATE Dec 76
NOTE 11p.

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Autism; *Child Language; Cognitive Development; Consonants; *Developmental Disabilities; *Language Development; Language Learning Levels; Linguistic Competence; Linguistic Performance; Mentally Handicapped; Neurolinguistics; Perception Tests; *Perceptually Handicapped; Phonemes; Phonology; Psycholinguistics; Psychological Tests; *Retarded Children; Sensory Integration; Speech; *Verbal Development

ABSTRACT

Work with verbal autistic children has demonstrated phonological, syntactic, and semantic production defects which are not understandable solely in terms of a developmental lag, but also suggest aspects of atypical linguistic development. This investigation is a preliminary attempt to test not only the production, but also the perception, of phonological variables in a group of autistic children, with the aim of identifying some of the atypical features of their linguistic competence when compared with normal children and children showing ideopathic mental retardation. This study also explores the potential contribution of such an approach to present-day theories of speech production and perception. Three groups of subjects were studied: normal, mentally retarded, and autistic children. In the production test, each child was given a picture naming test, constructed to elicit examples of the 24 consonant phonemes of English in initial, final, preconsonantal, postconsonantal, and intervocalic positions. The phonological perception abilities of the subjects were analyzed in two ways: the Wepman Auditory Discrimination Test (1973) and a false-positive test. The findings show that the autistic children make as many phonological mistakes as the mentally retarded and that they are particularly deficient in the production and perception of fricatives and liquids (classes mastered late in the normal developmental sequence). This suggests that autistic children are delayed in the development of phonological competence. (Author/NCR)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Eve V. Clark
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

ED161300

FL009837

PHONOLOGICAL PRODUCTION AND PERCEPTION IN VERBAL AUTISTIC, NORMAL, AND MENTALLY RETARDED SUBJECTS*

Sandra Pierce and Giampiero Bartolucci
McMaster University Medical School

The syndrome of childhood autism, notwithstanding a period of nosological confusion, has recently been demonstrated to be genetically distinct from the adult schizophrenias and childhood psychoses of later onset (Rutter, 1968) and to present a clinical evolution of its own (Kolvin, 1971). Childhood autism, therefore, is emerging as a more discrete syndrome than the broad group of childhood aphasias with which it has been compared (Rutter et al., 1971, Bartak et al., 1975).

Childhood autism is specifically characterized by onset at birth or within the first two to three years of life. Most frequently, the autistic child is first diagnosed as atypical only after the age of two. The diagnosis is usually based on the cooccurrence of the following characteristics.

1. A lack of responsiveness or active avoidance of the human figure, including avoidance of eye contact and the tendency to relate to only parts of the human figure;
2. A preoccupation with sameness in the environment as manifested by compulsive orderliness, ritualistic behavior, panic attacks or temper tantrums following changes in environment or in routine activities;
3. Language deviance characterized by abnormally slow development or loss of previous speech habits, by obvious echolalia, and the inaccurate use of personal pronouns.

This set of behavioral traits is in keeping with the original criteria set forth by Kanner (1948) and used by Rutter and other investigators in the field (Hermelin and O'Connor, 1970).

Within the last ten years, the syndrome has been conceptualized as a primary linguistic and cognitive disorder. A wealth of empirical observations, complemented by a few sketchy descriptions of autistic children's language, point to several shared linguistic peculiarities. For example, it has often been noted that autistic children tend to echo the statements

---

* This investigation was supported by Grant MA-5525, Medical Research Council, Ottawa, Ontario, Canada. Karen Batholomew assisted in the coordination of the study. The normal subjects were selected at random from the Grade One classes of St. Daniel's School, Hamilton, Ontario. The retarded children were similarly selected from the special education classes at Easthaven School, Hamilton, and the autistic youngsters were, in large part, identified through contacts with the Ontario Society for Autistic Children.

of others, to invert pronouns, and to have difficulties with the correct usage of prepositions, verbal tense, and conjunctions, as well as to have problems meeting the syntactic constraints on the subject-verb agreement and negative constructions (Rutter et al., Bartak et al.,1975, Simmons and Baltaxe, 1975). Broad systematic investigations of autistic language using a linguistic frame of reference are relatively rare (Bartolucci and Albers, 1974, Bartolucci et al., 1975, Bartolucci and Pierce, 1976).

Our work with verbal autistic children has demonstrated phonological, syntactic, and semantic production defects which are not solely understandable in terms of a developmental lag, but also suggest aspects of atypical linguistic development. Detailed studies of linguistic competence which tap the perception and comprehension of linguistic variables in these subjects have not been carried out to date. Our investigation is a preliminary attempt to test not only the production, but also the perception of phonological variables in a group of autistic children, with the aim of identifying some of the atypical features of their linguistic competence when compared with normal children and children showing ideopathic mental retardation. In the process, we also hope to explore the potential contribution of such an approach to present day theories of speech production and perception.

The expectation of atypical findings is based on the fact that we have previously demonstrated (Bartolucci et al., 1975) that autistic children show a significant correlation among measures of global cognitive functioning, number of errors in phonological production and overall level of syntactic development--a correlation not shown in mentally retarded subjects. As a consequence, we feel that this group may well be displaying an abnormality in some of the cognitive and representational features which underlie development at all linguistic levels.

Subjects

Three groups of subjects have been studied: normal, mentally retarded, and autistic children. All children were Caucasian, had English as their native language, and lived in or within a sixty-mile radius of Hamilton, Ontario.

The three groups have been matched according to nonverbal mental age, as measured by the Arthur Adaptation of the Leiter International Performance Scale (1952). Overall level of language development was measured by the Developmental Sentence Analysis technique of Lee (1974). The range of age and performance of all three groups is summarized in Table 1.

The autistic children were identified according to the presence of a definite history of the three clusters of behavioral characteristics already described.

The mentally retarded children were chosen according to a history of delayed development and IQ test results. None of the mentally retarded children showed any autistic features.

Table 1

GROUP CHARACTERISTICS

Variable	Autistic	Retarded	Normal
N	10	10	10
Male/Female	10/0	8/2	6/4
Age	$\bar{X}$ = 10.85 s = 2.28	$\bar{X}$ = 10.52 s = 2.99	$\bar{X}$ = 6.27 s = .27
MA (Leiter)	$\bar{X}$ = 6.58 s = 1.87	$\bar{X}$ = 6.08 s = 1.44	$\bar{X}$ = 6.37 s = .77
IQ (Performance)	$\bar{X}$ = 61.60 s = 18.0	$\bar{X}$ = 59.50 s = 12.22	$\bar{X}$ =101.80 s = 13.98
DSS (Raw Scores)	$\bar{X}$ = 6.7 s = 2.45	$\bar{X}$ = 8.55 s = 1.70	$\bar{X}$ = 10.26 s = 2.31

In identifying all subjects, care was taken to exclude children with demonstrable hearing loss, or with obvious or suspected neurological disorders, such as seizures.

Methodology

1. Production

Each child was given a picture naming test, constructed in such a way as to elicit examples of the twenty-four consonant phonemes of English in initial, final, preconsonantal, postconsonantal, and intervocalic positions, as far as the phonotactics of the language and the necessity of being able to draw a picture of the word permitted.

The responses were recorded with a condenser microphone on a Sony TC-106A taperecorder and subsequently transcribed using a modified version of the International Phonetic Alphabet.

2. Perception

Two different tasks were used to assess the phonological perception abilities of the subjects. The first was the Wepman Auditory Discrimination Test (1973), which contrasts the classes of stops, fricatives, and nasals, as well as some of the vowels of English. Responses to the vowel discrimination portion of the test were omitted, as the principal interest of our investigation at this time is in the perception of consonants.

The phonemes were tested either initially or finally in a monosyllabic English word, where all but the tested phoneme was held constant. Some of the word pairs were actually nonsense words for the children, as for example, vow-thou and sheaf-sheath. Nevertheless, as all the minimal pairs were composed of lexical items from the vocabulary of adult English speakers, presumably the perception test corresponded to actual speech processing.

The task was to discriminate between the members of a consonantal pair by responding "same" or "different". A training session prior to testing allowed the experimenter to judge the appropriate response mode for each subject. Depending on a child's demonstrated ability to use the words same or different, he was trained to respond by using both of these words; or by using "same" - "not same"; or to respond to the experimenter's question "Is that the same?" by answering "yes" or "no".

The test consisted of a total of twenty-six consonantal contrast pairs for which the appropriate response was "different". The number of identical pairs was minimal, but met the contrast-to-identical item mix of 3:1 considered sufficient to prevent the formation of a response bias for "different". (Graham and House, 1971)

The format of the second speech sound discrimination task was that of a false-positive test. The subject was presented with an object representing the stimulus word and a pile of pennies, as each new set of words was to be tested. He was taught prior to actual testing to put a penny on or in the object whenever he heard the stimulus word, and was cautioned not to get fooled by the other words he would hear that would sound like the one he was supposed to respond to.

Two phonemes, one occurring initially and one occurring finally, were selected as test items from each of the phoneme classes of stops, fricatives, affricates, nasals, and liquids. In addition, an initial glide was included, bringing the total number of tested phonemes to eleven. All words on the perception test are of the form CVC and also occur in the production test, in order to permit individual comparisons between the production and perception of phonemes. The presentation of one stimulus word constitutes a subtest.

In each subtest, the stimulus word was represented at least three times. It was randomly ordered with equal-sized sets of four other minimally different CVC words. The phonemes that could induce a false-positive response differed by one or more distinctive features from the phonemes

being tested, allowing for an analysis of the kinds of perceptual confusion which might take place. The desire to observe responses to a wide range of phonemes necessitated the use of a number of nonsense words in each subtest.

An example of the test procedure is as follows: On the subtest checking responses to the voiced stop /b/ in word-initial position, the child was first given a toy boat and some pennies and instructued to put a penny in the boat every time he heard the word boat. The following words were then presented at approximately ten second intervals: /powt/, /gowt/, /bowt/, /dowt/, /vowt/, /dowt/, /gowt/, /bowt/, etc.

In both the auditory discrimination tests, all items were presented by live voice. However, the tester stood behind the child so as to eliminate visual cues. It is believed that the disadvantage of the variability in the tester's pronunciation was outweighed by the advantage of being able to adjust the pace of the tests to the individual child's general behavior.

Results

1. Data Confirming Previous Findings

First of all, the data presented in our previous phonological production study of slightly different groups of autistic and mentally retarded subjects (Bartolucci et al., 1975) were confirmed. Although the three groups show no significant difference in mental age (MA), the Developmental Sentence Score (DSS) is significantly lower ($p < .05$) in the autistic groups, as compared to the normal group, with the mentally retarded occupying an intermediate position. Also, it is again only in the autistic group that a significant correlation between MA and DSS is found ($p < .05$).

2. Production Data

Since the total number of opportunities to produce a phoneme and the number of presentations of phonemes in the perception tasks are not identical, errors are compared in terms of percentages of the perfect score, in both production and perception tasks, unless otherwise specified.

Figure 1 depicts the mean error rates of the three groups by phonemic classes. Although no level of statistical significance is achieved, the greatest total number of errors in phonological production is made by the autistic group. When the errors in the classes of stops, fricatives, affricates, nasals, and liquids in the three groups are compared, using a two factor mixed design analysis of variance, a significant difference ($p < .001$) appears between the phoneme classes in all three groups.

To determine the nature of the difference, the phonological error pattern of the groups, viewed as a uniform population, was examined by a Scheffé test. Two distinct findings emerged: 1) Stop errors occur significantly less frequently than both fricative and affricate errors; and 2) There are significantly more mistakes made in the production of fricatives as compared to liquids.

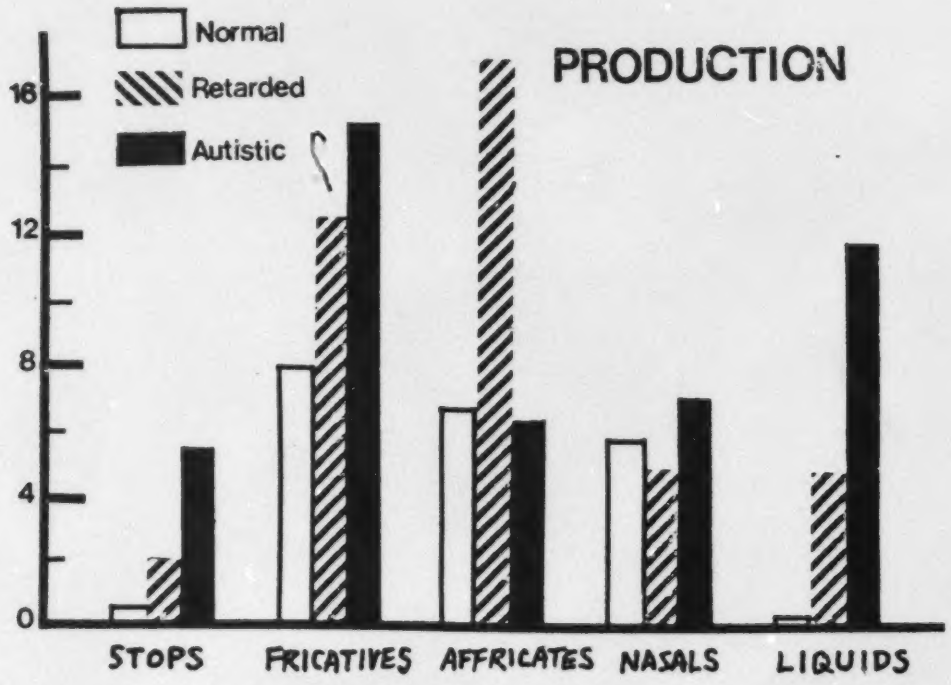

Figure 1. (%) errors in phonological production by phoneme classes

The analysis of variance also reveals a significant interaction between the groups and the errors ($p < .05$). This suggests that at least one of the groups displays a different pattern of phonemic class errors. When the error patterns of each group were compared individually no significant difference between the phonological behavior of the normal and autistic children appeared. The difference is, however, attributable to the retarded group, in that they make significantly more affricate than stop, nasal, or liquid errors.

Finally, statistical procedures comparing the error rates within classes of phonemes between the groups demonstrate a significant difference in errors ($p < .05$) in liquids between the autistic and the normal subjects.

In attempting to determine the relationship between mental age and total number of phonological production errors, we again confirmed our previous findings to the effect that a significant inverse correlation between MA and number of production errors is found only in the autistic subjects ($p < .02$).

3. Perception Data

Figure 2 presents an overview of our perception data. A two factor mixed design analysis of variance shows that a significant difference ($p < .001$) exists among the total percentages of perception errors in the

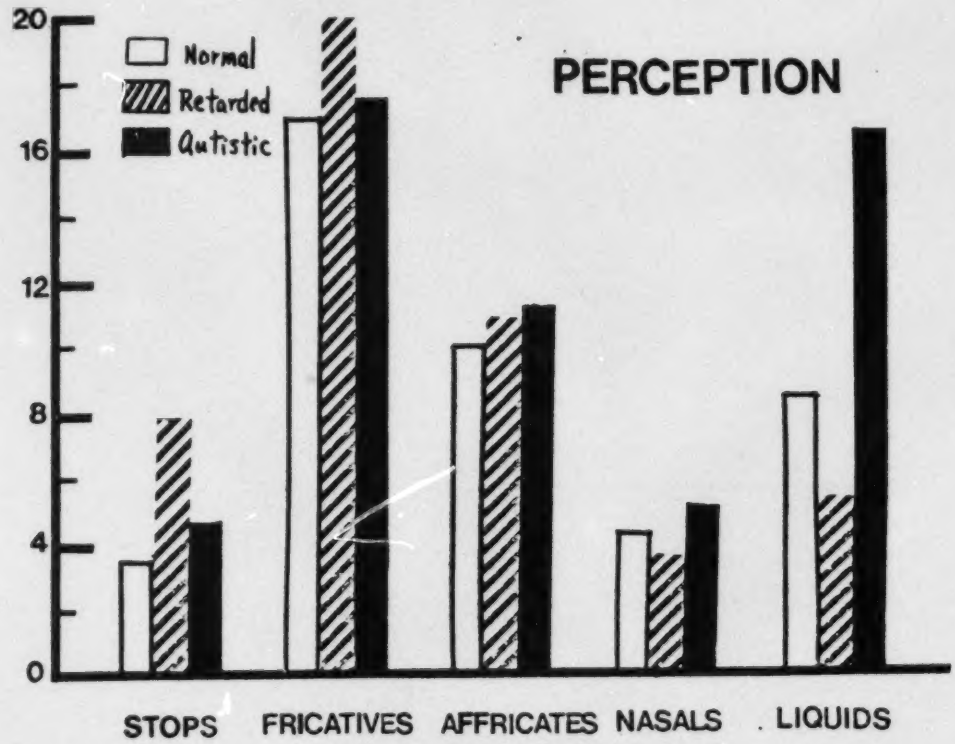

Figure 2. (%) errors in phonological perception (false-positive test) by phoneme classes

different phoneme classes. Once again, a Scheffé test was done on the pooled data to determine where the difference lies. The result showed that there are significantly ($p < .05$) more errors made in the class of fricatives than are made in any of the other phoneme classes. Moreover, the difference between affricates and nasals and between liquids and nasals reaches significance at the .05 level.

There is no significant interaction between groups. This means that in spite of the fact that the overall percentages of phonemic class errors differs among the groups, their patterns of errors do not differ substantially. When the variability among group performance within each phoneme class is tested, the autistic group makes a significantly greater number of mistakes in the perception of liquids than do the retarded children ($p < .05$). The difference between the autistic and the normal subjects is significant at the .1 level.

Word-initial versus word-final perception errors were compared, and since no correlation with the production data was sought at this time, errors were expressed in absolute numbers, rather than as percentages. The results indicate a significantly higher number of errors in the perception of consonants in word-final position in all groups ($p < .001$).

The data obtained from the Wepman confirm the higher incidence of errors in word-final position ($p < .001$), as well as showing a significantly greater number of fricative errors when compared with stops in all groups ($p < .001$).

4. Relationship Between Perception and Production Data

A comparison of the sum of the percentages of class errors in production and in perception (the false-positive test) demonstrates a predominance of perception errors in all groups ($p < .05$).

The Wepman shows significance in the same direction, although, since the test is incomplete, this can only be demonstrated for the production versus perception of stops and fricatives ($p < .001$).

When the relationship between production and perception within the fricative and liquid classes was compared, in both cases all groups showed a higher number of errors in perception ($p < .01$ - liquids, $p < .025$ - fricatives).

In comparing the relationship between mental age and number of phonological perception errors, it was only in the autistic group that a significant inverse correlation between MA and the number of perception errors appears ($p < .05$).

Discussion of the Findings

The fact that the autistic children make as many phonological mistakes as the mentally retarded and that they are particularly deficient in the production and perception of phonemes belonging to the fricatives and liquids - classes mastered late in the normal developmental sequence (Menyuk, 1971) - suggest that autistic children are delayed in the development of phonological competence. Such delay is formally similar to that found in the mentally retarded group, although the latter is more deficient in the area of affricate production and fricative perception.

The autistic group, on the other hand, differs significantly from the normal group in the production of liquids. They also make more frequent errors than the normal and the mentally retarded in the perception of these phonemes. Therefore, we have two findings which typify the autistic group: 1) the correlation between mental age and level of phonological competence, and 2) a strong suggestion of a specific lag in the mastery of liquids. In order to bring these findings together, we offer the following interpretation: Of all the phonemes of English, the liquids are the most obscure in their translation into articulatory gestures. In the case of the other phoneme classes there are clearly marked "anchor points" in the vocal tract which produce the acoustic signals matching those perceived (Menyuk, 1971).

The production and perception of liquids involves a more complex interaction within the supralaryngeal portion of the mouth, and therefore a more detailed internal representation of this segment and of the tongue's positioning within it.

Empirical investigations have shown that the body-image of autistic children appears to be defective. Their agnosia of body parts leads to difficulties in imitating the body movements of others (DeMyer, et al., 1972). We propose that the autistic children's problems with liquids is one more manifestation of the same abnormality. This interpretation obviously suggests that the development of phonological competence is partially dependent on the parallel development of cognitive structures which allow for the representation of specific segments of the body, such as the supralaryngeal tract, (Lieberman, 1975) and the integration of motor and sensory functions.

When viewed on a broader plane, our findings concerning the mastery of phoneme classes are not in conflict with other research in the field, and reflect the generally accepted order of phonemic development. The correlation between production and perception--in that those classes more poorly produced are also those more poorly perceived--also corresponds to other reports in the literature.

Unexpected though, is the gap that was found in all three groups between production and perception. Perhaps the explanation lies in the nature of our perception tasks. When asking for a judgment, we are no longer tapping in any immediate fashion the perception of phonemes. We are introducing cognitive variables that go beyond perception as such, so that the discrepancy between perception and production may be due to the overinclusiveness of our test, which taps not only phonemic perception, but also level of cognitive development, by demanding a judgment during the completion of the task.

REFERENCES

Arthur Adaptation of the Leiter International Performance Scale. The Psychological Service Center Press, 1952.

Bartak, L., M. Rutter, and A. Cox. A comparative study of infantile autism and specific developmental receptive language disorder. British Journal of Psychiatry, 1975, 126, 127-145.

Bartolucci, G. and R. J. Albers. Deictic categories in the language of autistic children. Journal of Autism and Childhood Schizophrenia, 1974, 2, 131-141.

Bartolucci, G. and S. Pierce. Aspects of the syntactic development of verbal autistic children. In preparation, 1976.

Bartolucci, G., S. Pierce, D. Streiner, and P. Tolkin-Eppel. Phonological investigation of verbal autistic children and mentally retarded subjects. McMaster University, mimeo, 1975.

DeMyer, M., G. Alpern, S. Barton, W. DeMyer, D. Churchill, J. Hingtgen, C. Bryson, W. Pontius, and C. Kimberlin. Imitation in Autistic, early schizophrenic, and non-psychotic subnormal children. Journal of Autism and Childhood Schizophrenia, 1972, 2, 264-287.

Graham, L. and A. House. Phonological oppositions in children: a perceptual study. Journal of the Acoustical Society of America, 49, 559-594, 1971.

Hermelin, B. and N. O'Connor. Psychological experiments with autistic children. New York: Pergamon Press, 1970.

Kanner, L. Child Psychiatry. Springfield, Illinois: Charles C. Thomas, 1948.

Kolvin, I. Psychoses in childhood--a comparative study. In M. Rutter (ed.) Infantile autism: concepts, characteristics and treatment. London: Churchill Livingstone, 1971.

Lee, L. Developmental sentence analysis. Evanston, Illinois: Northwestern University Press, 1974.

Lieberman, P. On the origins of language. New York: Macmillan, 1975.

Menyuk, P. The acquisition and development of language. Englewood Cliffs, N.J.: Prentice-Hall, 1971.

Rutter, M. Concepts of autism: a review of the research. Journal of Child Psychology and Psychiatry, 1968, 9, 1-25.

Rutter, M., L. Bartak, and S. Newman. Autism--a central disorder of cognition and language? In M. Rutter (ed.) Infantile autism: concepts, characteristics and treatment. London: Churchill Livingstone, 1971.

Simmons, J. and C. Baltaxe. Language patterns of adolescent autistics. Journal of Autism and Childhood Schizophrenia, 1975, s, 333-351.

Wepman Auditory Discrimination Test. The University of Chicago Press, revised form 1973.